

an aqueous slurry comprising water, submicron particles such as boehmite, and an oxidizing agent. The rejection under section 102(e) is respectfully traversed for the following reasons.

Regarding claim 22, the method claim includes the step of "forming a slurry containing abrasive boehmite particles by dipping particles of aluminum in heated water." While Wang mentions the use of boehmite slurries for a polishing process, the patent fails to teach or suggest the limitation of dipping particles of aluminum in heated water to form the boehmite slurry. The present specification at page 11 teaches this step, and, as mentioned above, the step is included in independent claim 22.

Independent claims 12 and 21 iterate that the polishing is performed in a basic atmosphere. The instant specification, in Example 3, discloses that the slurry is suspended in a solution of potassium hydroxide, water, and another alcohol. In contrast, the slurries prepared according to the Wang disclosure are acidic suspensions. At column 3, lines 55 to 62, Wang discloses that compounds such as potassium hydrogen phthalate and ammonium hydrogen phthalate are included in the slurries. These compounds have at least two acid groups, and the pK_a of the first dissociable acid is not substantially larger than the pH of the polishing slurry composition. Accordingly, Wang teaches away from polishing in a basic

atmosphere.

In section 6 of the Office Action, the Examiner asserts that Wang teaches the use of oxidizing agents as well as the above phthalate compounds. The Examiner then concludes that Wang teaches both an acidic and basic atmosphere. This is incorrect.

Wang teaches the use of the phthalate compounds together with oxidizing agents (col. 3, lines 46 to 53). However, the key point is Wang's teaching that the phthalate compounds have at least two acid groups, and the pK_a of the first dissociable acid is not substantially larger than the pH of the polishing slurry composition (col. 3, lines 55 to 62). The phthalate compounds, and the method of using them, are referred to by Wang as falling within the scope of U.S. Patent No. 5,391,258, issued to Brancaleoni et al. ("Brancaleoni"). A copy of the Brancaleoni patent is included with this paper.

Brancaleoni teaches that whenever phthalates are used in a polishing process, the pH of the polishing slurry is very acidic even when oxidizing agents are applied to the slurry. Furthermore, the pK_{a1} of phthalic acid is 2.95 (col. 4, line 46). Examples 1 and 3 give examples of polishing compounds using phthalate compounds, and in every case the pH of the solution is much less than 7. Because Wang teaches use of phthalate compounds in a polishing slurry as taught by Brancaleoni, and Brancaleoni only teaches the use of slurries

in an acidic environment, Wang fails to teach or suggest that the polishing is performed in a basic atmosphere.

"A claim is anticipated [under 35 U.S.C. § 102(e)] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. Because Wang does not disclose polishing in a basic atmosphere, or the step of dipping aluminum in hot water to form boehmite, each and every limitation in claims 12, 21, 22, and 27 is not taught or suggested by Wang, and the rejection of that claim under 35 U.S.C. § 102(e) should be withdrawn.

Rejections Under 35 U.S.C. § 103(a)

Claims 13 to 14, and 23 to 26 stand rejected as being unpatentable over Wang in view of U.S. Patent No. 5,445,807, issued to Pearson ("Pearson"). Claims 16 to 20, and 25 to 26 stand rejected as being unpatentable over Wang in view of Pearson, and further in view of U.S. Patent No. 5,723,019, issued to Krusell et al. ("Krusell"). For the following reasons, these rejections are respectfully traversed.

The differences between Wang and independent claims 12, 21, and 22 set forth above are incorporated herein by reference to avoid unnecessary repetition. In light of these

differences, each and every limitation of claims 13 to 14, 16 to 20, and 23 to 26 is not provided by Wang, and the rejection of these claims should be withdrawn. "To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)." M.P.E.P. § 2143.03. Accord. M.P.E.P. § 706.02(j). It is also pointed out that neither Krussel nor Pearson provide a teaching or suggestion of polishing in a basic atmosphere, or the claimed step of forming the boehmite slurry by dipping aluminum in hot water. Krussel is directed to cleaning of a wafer, and not to a polishing method. Pearson is directed to formation of aluminum compounds, but not the use of such compounds in a polishing step, and thus makes no mention of polishing in a basic atmosphere. Accordingly, the deficiencies of Wang are not provided for by either of the secondary reference, and the obviousness rejections can not stand.

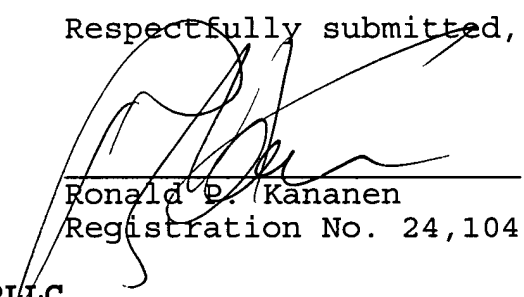
Claim 16 includes the limitation that the abrasive particles in the slurry consist essentially of boehmite. As mentioned above, neither Pearson nor Krusell discloses any type of slurry. Wang does disclose slurries that contain boehmite particles. However, the Wang slurries do not contain abrasive particles that consist essentially of boehmite. Rather, Wang slurries include submicron alpha-alumina particles as an essential and inventive component, in addition

to substantially less abrasive particles, that may include aluminum oxide materials such as boehmite. Accordingly, the "consisting essentially of" limitation of claims 16 to 20 is not taught or suggested by any of the prior art references of record, and the rejection of claims 16 to 20 under 35 U.S.C. § 103(a) should be withdrawn.

For the foregoing reasons, all the claims now pending in the present application are believed to be clearly patentable over the prior art of record. Accordingly, favorable reconsideration of the newly-presented claims in light of the above remarks is courteously solicited. If the Examiner has any comments or suggestions which could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number.

Respectfully submitted,

DATE: 28 June 2000



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AppendixClaims as Pending

12. A chemical-mechanical polishing process for planarizing one or more thin films formed on a substrate, wherein the chemical-mechanical polishing is performed using a slurry containing abrasive particles containing boehmite in a basic atmosphere.

13. A chemical-mechanical polishing process according to claim 12, wherein the particles of boehmite are formed by dipping of particles of Al in hot water.

14. A chemical-mechanical polishing process according to claim 13, wherein said hot water is added with sodium aluminate.

16. A chemical-mechanical polishing process for planarizing one or more films formed on a substrate, wherein said thin films are subjected to chemical-mechanical polishing using a slurry containing abrasive particles consisting essentially of boehmite, and the residual slurry and contamination are removed by spin cleaning.

17. A chemical-mechanical polishing process according to claim 16, wherein said spin cleaning is performed using

chemicals comprising a solution containing NH_4 , H_2O_2 , and H_2O , followed by a hydrofluoric acid solution.

18. A chemical-mechanical polishing process according to claim 17, wherein after spin cleaning using said chemicals, said substrate is rinsed with pure water.

19. A chemical-mechanical polishing process according to claim 16, wherein the abrasive particles of boehmite are formed by dipping of particles of Al in a hot water.

20. A chemical-mechanical polishing process according to claim 19, wherein said hot water is added with sodium aluminate.

21. A chemical-mechanical polishing process for planarizing one or more of thin films formed on a substrate, wherein said chemical-mechanical polishing is performed using a basic slurry containing abrasive particles made of a material higher in hardness than SiO_2 .

22. A polishing process which comprises the steps of:
forming a slurry containing abrasive boehmite particles by dipping particles of aluminum in heated water; and
planarizing at least one film formed on a substrate by

employing a chemical-mechanical polishing process using said slurry.

23. A polishing process according to claim 22, wherein said step of forming a slurry includes adding sodium aluminate to said heated water.

24. A polishing process according to claim 22, wherein said heated water is about 80 °C.

25. A polishing process according to claim 22, wherein said chemical-mechanical polishing process is performed in a basic atmosphere.

26. A polishing process according to claim 25, wherein said boehmite particles are suspended in a solution containing KOH, water, and an alcohol.

27. A polishing process according to claim 22, wherein said film is an interlayer dielectric film.